Reply to HEPTH-9509028

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Much is known about the charged sectors of Quantum Electrodynamics (QED). The state space displays rich superselection sectors where, in particular, the velocity of charged particles, like the electron, labels different sectors[1,2]. The BRST charge can be used effectively to project out the gauge invariant, physical states, but the resulting state space is an infinite tensor product of these superselection sectors, i.e., the BRST charge is not capable, on its own, of distinguishing between these physically distinct sectors. In our letter[3] we introduced a new, non-local, non-covariant symmetry that projected out the static sector of QED (described by Dirac's dressed electron). The non-static extension of Dirac's construction are still BRST, and indeed anti-BRST, invariant, but are *not* invariant under our symmetry. As such our symmetry, in conjunction with BRST, can be used to extract an irreducible sector of the intricate structure of QED. Indeed, as one would expect to be able to recover the other, velocity dependent sectors in a similar fashion, we conjecture that our symmetry is but one member of a whole class of distinct, new, non-covariant symmetries of QED.

In our presentation of the symmetry we took great pains to show that it really is a symmetry of QED. In the comment a simplistic argument is presented in *free* QED (which is, after all, a trivial theory without interaction or charges and which hence lacks the above superselection sectors) to claim that our symmetry is no more than a "a non-local version of standard BRST". No matter what the merits of these arguments are for the free theory, this is manifestly not true for the interacting theory. The comment exemplifies the dangers of formal manipulations of path integrals in non-trivial theories like the full version of QED.

On a lesser note, we point out that Tang and Finkelstein's work[4] is not a covariant version of our symmetry; as far as we are aware this has also never been suggested by those authors.

References:

[1] R. Haag, *Local Quantum Physics*, (Springer-Verlag, Berlin, Heidelberg, 1993).

[2] D. Buchholz, *Commun. Math. Phys.* **85** (1992) 49.

[3] M. Lavelle and D. McMullan, *Phys. Rev. Lett.* **71** (1993) 3758.

[4] Z. Tang and D. Finkelstein, *Phys. Rev. Lett.* **73** (1994) 3055.